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SAFETY AND QUALITY ISSUES IN CONSTRUCTION INDUSTRY

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ABSTRACT

Quality and safety are two important issues in the construction industry. The industry not only looks for good quality buildings but is also keen to promote a safe working environment on construction sites. Quality management systems (QMS) as well as safety management systems (SMS) are already in place in many countries where quality and safety issues are dealt with respectively. Unfortunately, both systems are frequently considered separately. Although dramatic improvements have taken place in recent decades, the safety record in the construction industry continues to be one of the poorest. Research shows that the major causes of accidents are related to the unique nature of the industry, human behaviour, difficult work site conditions, and poor safety management, which result in unsafe work methods, equipment and procedures. Quality is one of the critical factors in the success of construction projects. Although quality

management at every stage of project life cycle is important but the quality management at the execution (construction) stage contributes significantly on final quality outcome of construction projects. This project mainly focuses the importance and factors that affects the safety management and quality management in the execution (construction) phase. The project also includes visiting of some construction companies and conducts the questionnaire survey, then analyse the difficulties (major factors) and the cost variance due to safety and quality defects in safety and quality management and suggests some proactive measures for the improvement of safety and quality in the execution phase of construction projects.

INTRODUCTION

Quality control and safety represent increasingly important concerns for project

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managers. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities. Accidents during the construction process can similarly result in personal injuries and large costs. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents occur on the project.

As with cost control, the most important decisions regarding the quality of a completed facility are made during the design and planning stages rather than during construction. It is during these preliminary stages that component configurations, material specifications and functional performance are decided. Quality control during construction consists largely of insuring conformance to this original design and planning decisions. Safety during the construction project is also influenced in large part by decisions made during the planning and design process. Some designs or construction plans are inherently difficult and dangerous to implement, whereas other, comparable plans may considerably reduce the possibility of accidents. For example, clear separation of traffic from construction zones during roadway rehabilitation can greatly reduce the possibility of accidental collisions. Beyond these design decisions, safety largely depends upon education, vigilance and cooperation during the construction process. Workers should be constantly alert to the possibilities of accidents and avoid taken unnecessary risks. Quality of construction projects is linked with proper quality management in all the phases of project life cycle. Design and construction are the two important phases of project life cycle which affect the quality outcome of construction projects significantly.

LITERATURE RIVEW

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Husrul Nizam Husin (2008) – Analysed an overview of construction quality and safety reveals many striking similarities for these two management concept. Programs that have been developed to improve quality and safety performance have many elements in common. In some cases safety is considered a part of Total Quality Management (TQM). The close relationship between quality and safety implies that benefits would be derived by applying some or all of the following propositions: (1) Consolidate the safety and quality functions; (2) Apply quality concept to safety; (3) Optimize the safety management concept; and (4) Apply the results of safety aspects to quality. This paper aim to provide a basis framework, this seminar which titled

“Safety Management towards Quality Construction” tries to delineate the relationship and the importance of these two areas. A proposed model which is also a framework is seen as a procurable method on defining the basic concept of safety management meant to achieve the expected quality level. In the aspect of proposing safety application model, a directive method of the Total Quality Management is used. A basic management application model as suggested by Walker (1993), is proposed to be used as a generic model to highlight the key features. Findings from individual survey are used to delineate the key points or processes of the safety application model.

Esra Bas (2012) – Presented a systems thinking approach for safety by tracing the relationships between tasks performed by a worker, the hazard inherent while performing the task, the events that canaries from the hazard, and finally the preventive/protective measures that serve as feedback to the task design such that a closed loop is obtained for continuous review of the interactions and continuous improvement of the system. The proposed approach does not intend to create a direct causal loop diagram, but to show how specific tasks can relate to specific hazards, which in turn relate to specific events, and

finally what preventive/protective measures can be introduced against the events, so that tasks can be performed in a safer environment with the selected preventive/protective measures. The systems thinking approach proposed in this paper can guide a more careful selection of tasks as a result of tracing the inter-relationships among the parameters, such that the tasks with a high probability of leading to events that cause damage to people and the company may even be omitted or a task design supported by preventive/protective measures can be performed in a safer environment. Moreover, the proposed methodology is extended to involve different players in the whole system in a country, where the feedback from different companies is reflected in country-wide databases for different industries.

Sai X. Zeng¹ et al, (2010) – Reviewed the Construction is considered to be one of the most hazardous industries due to its unique nature around the world. Traditionally, safety and quality in the construction industry are always of grave concerns. In recent years, the construction industry has also faced public pressures on environmental protection due to the pollution and hazards created by construction activities. There are different factors affecting safety risk in construction. Using association rule mining, identified the characteristics of occupational injuries in the construction industry. In addition to general factors, several factors related to weather conditions were analyzed. The results showed that there are some patterns of occupational injuries in the construction industry; e.g. the effect of rain on the occurrence of fatalities is of great significance.

Abdul Hakim Mohammed et al, (2006) Investigated the construction industry is being viewed as one with poor quality emphasis compared to other sectors like the manufacturing and service sectors. Many criticisms have been directed to the construction industry for generally shoddy workmanship. It not only the final product that

is subject to criticisms but the processes, the peoples, the materials etc are under tremendous pressure for better quality in construction. Total quality management (TQM) is increasingly being adopted by construction companies as an initiative to solve quality problems in the construction industry and to meet the needs of the customer. TQM has the potential to improve business results, greater customer orientation and satisfaction, worker involvement and fulfilment, team working and better management of workers within companies. However, construction firms have been continually struggling with its implementation. Cultural change is being recognised as an important aspect of total quality development. However, the issue surrounding quality culture has not been comprehensively studied. This paper will discuss the issues of quality culture and its development in the construction industry.

SCOPE OF STUDY

Safety management in the construction industry helps to identify the risks and reducing accidents to improve site productivity and project. While in quality management it helps to produce good quality products to work in the construction industry. Sometimes quality products control the accidents in construction site. In this project it explains about the safety and quality issues in construction industry and how to rectify from the accidents and to produce good quality products. This project proposes to investigate the adoption and implementation of QMS and SMS in the construction industry and develop a “measurement methodology” of construction processes for customer satisfaction and continuous improvement. The main concept of this project will be to identify “what” processes can be measured and “how” to measure them. To identify the above objectives literature search and questionnaires will be used.

METHODOLGY

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From the literature survey it had been learnt concluded there are many issues about safety and quality in construction industry. Due to time constraint for the project, the descriptive survey method is to be adopted, whereas other methods may take long duration. Several methods for collecting information from the industry were evaluated from various literatures. The following steps are carried out in the project. These are after title conformation relevant literatures were collected. From the literature the problem and issues were identified. Framing the questionnaires based on the analysis from the various people of construction industry, literature review. Group the companies based on the methodology Conduct the questionnaire survey in predefined companies Find out the factors that affects the quality of construction Conclusion

SAFETY IN CONSTRUCTION SITE

The leading safety hazards on site are falls from height, motor vehicle crashes, excavation accidents, electrocution, machines, and being struck by falling objects. Some of the main health hazards on site are asbestos, solvents, noise, and manual handling activities. Falls from heights are the leading cause of injury in the construction industry. Fall protection is needed in areas and activities that include, but are not limited to: ramps, runways, and other walkways; excavations; hoist areas; holes; formwork; leading edge work; unprotected sides and edges; overhand bricklaying and related work; roofing; precast erection; wall openings; residential construction; and other walking/working surfaces.

Motor Vehicle Crashes are another major safety hazard on construction sites. It is important to be safety cautious while operation motor vehicles or Equipment on the site. Motor vehicles shall have a service brake system, emergency brake system, and a parking brake system. All vehicles must be equipped with an audible warning system if the operator chooses to use it. Vehicles must

have windows and doors, power windshield wipers, and have a clear view of site from the rear window no person is allowed to cross underneath or stand underneath any loading or digging equipment. Employees are to remain at a safe distance from all equipment while it is operational.

BASIC RULES FOR SAFETY

You should have a good understanding of your working environment and the instructions given by your supervisor. When evacuation is required in an emergency, you should keep calm and find out:

- What dangerous situation the alarm refers to.
- The routes for evacuation.
- The safe place that you should go to as designated by the company. When someone is found seriously injured, you should:
 - Keep calm.
 - Seek help immediately.
 - Accompany the injured person.
 - Assist in the immediate rescue work as far as possible.
 - Call the site safety staff.
 - Do not try to move the injured person unless it is really necessary to do so.
 - Do not tamper with the accident scene while waiting for the arrival of the investigation team. When a fire breaks out, you should remember:
 - Put out the fire with a fire extinguisher if it is a small fire.
 - If the blaze is out of control, do not try to extinguish the fire on your own. Call the Fire Services Department right away. Emergency telephone numbers.
 - Always pay attention to the emergency telephone numbers posted on the notice board in the site office.

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Fig 4.1: safety rules



Safety remains an on going concern for the construction manager. Construction by nature is inherently dangerous, with a high degree of hazard and risk. The toll of construction accidents is high in terms of both costs (\$) and human suffering. Accidents add a tremendous burden of needless and avoidable expense. Financial losses pale when compared to bodily injury and death, and the resulting human, social impacts. Construction accidents add \$10 billion annually to construction cost. Insurance (such as workmen’ compensation) protects the contractor from certain direct expenses, but accidents also involve substantial costs that are not insurable, referred to as hidden or indirect cost. Direct costs include medical cost and compensation. Indirect or hidden costs include:

- Time lost from work by the injured party
- loss in earning power, economic loss to injured workers family
- diminished quality of life for the injured party
- loss of efficiency by breaking up crew
- cost to train new or replacement employees
- damage to equipment and tools
- loss of production
- cost incurred by delays
- failure to meet contract demands (completion, etc)
- overhead costs associated with disruption of work
- cleanup and repair costs



Fig 4.2: safety equipments



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- administrative costs of investigations and reports
- increased insurance premiums
- loss of future projects due to adverse publicity
- cost of fines
- many, many others difficult to quantify.

SAFETY HAND BOOK FOR CONSTRUCTION SITE WORKS

Most accidents can be prevented by taking simple measures or adopting proper working procedures. This handbook is intended to outline important issues on safety and health that should be paid attention to on construction sites for easy reference by the workers. If we work carefully and take appropriate safety measures, there will definitely be fewer work injury cases, and our sites will become a safe and secure place to work in. The Occupational Safety and Health Ordinance, which came into operation on 23 May 1997, covers most workplaces in order to protect the safety and health of employees at work. Other legislation applicable to construction sites includes the Factories and Industrial Undertakings Ordinance and its subsidiary legislation, particularly the Construction Sites (Safety) Regulations.

QUALITY

In manufacturing, a measure of excellence or a state of being free from defects, deficiencies and significant variations. It is brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer or user requirements. ISO 8402-1986 standard defines quality as "the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs.

QUALITY IN CONSTRUCTION INDUSTRY

Quality of construction projects is linked with proper quality management in all the phases of project life cycle. Design and construction are the two important phases of project life cycle which affect the quality outcome of construction projects significantly. This paper therefore, focuses on the quality management in the execution phase of construction projects. The aim of this paper is to highlight the importance of quality management in the execution phase of construction projects.

ISO 8402 defines quality as the degree of excellence in a competitive sense, such as reliability, serviceability, maintainability or even individual characteristics. We usually think of "quality" in terms of an excellent product or service that fulfils or exceeds our expectations. These expectations are based on the intended use and its cost. According Dale Bester field (Quality Control, A Practical Approach, 7th edition, 2004), Quality can be expressed as:

$$Q = P / E$$

Where: Q = Quality

P = Performance

E = Expectation

If Q is greater than 1.0, then the customer has a feeling of great satisfaction about the product or service rendered. The determination of Q is based on perception, with the contractor determining performance and the customer determining expectations. The customer expectations are continually becoming more demanding.

QUALITY MANAGEMENT

Quality management refers to all activities of overall management functions, especially top management leadership, that determine quality policy objectives and responsibilities for all members of the organization

QUALITY PLANNING

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No. of participating companies	50
No. of responded companies	40

Quality Planning is identifying which quality standards are relevant to the project and determining how to satisfy quality standards.

PARE TO ANALYSIS

It is a technique employed to prioritize the problems so that attention is initially focused on those, having the greatest effect. It was discovered by an Italian economist, named Wilfred Pareto, who observed how the vast majority of wealth (80%) was owned by relatively few of the population (20%). As a generalized rule for considering solutions to problems, Pareto analysis aims to identify the critical 20% of causes and to solve them as a priority.

FLOWCHARTS

Flow chart is used to provide a diagrammatic picture using a set of symbols. They are used to show all the steps or stages in a process project or sequence of events. A flowchart assists in documenting and describing a process so that it can be examined and improved. Analysing the data collected on a flowchart can help to uncover irregularities and potential problem points.

STATISTICAL ANALYSIS

Statistics is the study of the collection, organization, analysis, interpretation and presentation of data. It deals with all aspects of data, including the planning of data collection in terms of the design of surveys and experiments.

PDCA CYCLE

PDCA is an iterative four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the Deming circle/cycle/wheel, Stewart cycle, control circle/cycle, or plan–do–study– act. Another version of this PDCA cycle is OPDCA. The added "O" stands for observation

COMPANY IDENTIFICATION

Companies for questionnaire survey are mainly classified in to 3 types according to their cost. They are high level, middle level, and low level companies.

- High level companies their project cost is more than 100 crore,
- Middle level companies project cost ranges from 5 to 100 crore, and
- Low level company’s project cost less than 5 core.

The high level companies are located in Chennai, Bangalore areas and the middle and low level companies are located in Coimbatore, thiruppur, erode areas.

DESIGN OF QUESTIONNAIRE

A questionnaire was designed to study more about the safety and quality management practices in the construction industry and ways to improve both in construction works. The questionnaires were prepared with reference of literature reviews and field persons like contractors, engineers, project managers and consultant. Because field people are very well know about, what are all the factors affecting the safety and quality majorly. Questionnaires are mainly focused on the execution part

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particularly superstructure. Because the quality of construction is majorly misplace in execution part. Questionnaire mainly divided into five main categories. These are column work, beam work, slab work, brick or block work and plastering work. Lot of factors affecting the construction quality but in this project I only focuses on major factors like concreting work (concrete quality, pouring of concrete, compaction, curing, etc.), man power, material quality, equipment quality, detailing, etc. Develop the kinds of questions and sub-questions that need to be asked. When developing the survey, questions were formulated so that they could help to answer the questions. A draft questionnaire was developed consisting of five sections. Determine the population and sample to be selected. The survey sample comprised clients, contractors and consultants. Within each group those persons who worked with risk management in a particular project were identified. The following categories, representing the main actors in the construction project were defined: From the client's side: Representative signing the contract; Project manager. From the contractor's side: Representative signing the

contract; Site manager; Estimator. Consultants (design manager or architect) Finalize the questionnaire, making any necessary adjustments. After the meeting with the respondents the questionnaire was adjusted. Some questions were excluded, some reformulated and completed.

QUALITY MANAGEMENT

COLUMN WORK

1. Does the column marking is affect the quality?
2. Is there any kind of problem arise due to insufficient Reinforcement?
3. Is there any kind of quality problem arise due to poor design?
4. Is there any kind of quality problem arise due to poor design?

5. Is there any kind of quality problem arise due to poor design?
6. Is there any kind of quality problem arise due to manpower in site?
7. Is there any kind of quality problem arise due to equipment used in site?
8. Does the poor quality of concrete is affect the quality of column?
9. Is there any kind of quality problem arise due to compaction of concrete?
10. Is there any kind of quality issue arise due to improper curing of column?
11. Is there any kind of problem arise due to insufficient reinforcement?
12. Is there any kind of quality problem arise due to shuttering work?
13. Does the poor cover block placement is affect the quality of beam?
14. Is there any kind of quality problem arise due to manpower in site?
15. Is there any kind of quality problem arise due to equipment used in site?
16. Does the poor quality of concrete is affect the quality of beam?
17. Is there any kind of quality problem arise due to compaction of concrete?
18. Is there any kind of quality issue arise due to curing of beam?
19. Does the reinforcement is not providing as per reference drawing?
20. Is there any kind of quality problem arise due to shuttering work?
21. Does poor cover block placement affect the quality?
22. Is there any kind of problem arise related to electrical lining?
23. Is there any kind of quality problem arise due to manpower in site?
24. Is there any kind of quality problem due to equipment used in site?
25. Does the quality of concrete is affect the quality of slab?
26. Is there any kind of quality problem due to compaction of concrete?
27. Is there any kind of quality issue due to curing of slab?
28. Does any kind of quality problem due to improper drawing study?

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29. Does the right angle marking is affect the quality of block work?
30. Does the starter course lying is affect the quality of block work?
31. Does the proportion of mortar mix is affect the quality?
32. Is there any kind of problem due to poor quality of brick or block?
33. Is there any kind of problem arise due to not wetting the brick or block before lying?
34. Is there any kind of quality problem due to manpower in site?
35. Is there any kind of problem due to not pointing of joints?
36. Is there any kind of quality issue due to curing of wall?
37. Is there any kind of fault due to improper button marking fixing?
38. Does mortar proportion affect the quality?
39. Is there any kind of quality problem due to manpower in site?
40. Is there any kind of quality issue due to curing of surface?

The most important factors affecting the construction safety are:

1. Maintaining safe work conditions;
2. Establishing of safety training;
3. Educating workers and supervisors to have good safety habits;
4. Effective control by main contractor of the numerous sub- contractors;
5. Maintaining a close supervision to the workers and

FACTORS AFFECTING QUALITY

Factors such as conflict among project participants; Hostile socio-economic and climatic condition; Ignorance and lack of knowledge; Some project specific factors; Aggressive competition at the tender stage are found to adversely affect the quality performances of projects.

CONCLUSION

The result of this thesis will expose the main factors which affect the construction safety and quality and also increase in cost of construction due to safety and quality defect. This study will create the quality and safety management awareness to all level construction companies especially small scale companies. From this thesis we get the major factors and issues which affects the construction safety and quality and that create a chance for find out the remedial measure. This thesis is useful for minimize the material wastage, workmanship wastage, time wastage and indirect cost. Then increase the customer satisfaction and company reputation.

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